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ABSTRACT

This module on antidiabetic agents is intended for use in inservice or continuing education programs for persons who administer medications in long-term care facilities. Instructor information, including teaching suggestions, and a listing of recommended audiovisual materials and their sources appear first. The module goal and objectives are then provided. A brief discussion follows of the disease process of Diabetes Mellitis; the use of hypoglycemic medications, their actions, side effects, and interactions with other drugs; and considerations and suggestions for resident care. This discussion is intended for use as a lecture or participant reading. Other contents include a worksheet, a diagram of the endocrine system, a vocabulary exercise, and drug charts, all of which are suitable for reproduction for use as handouts. (YLB)

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ANTIDIABETIC AGENTS

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Antidiabetic Agents

Instructor Information

This material is intended for use in inservice or continuing education facilities. It includes a brief discussion of the disease process of Diabetes Mellitis, the use of hypoglycemic medications, their actions, side effects and interactions with other drugs. The worksheet and drug charts may be duplicated and distributed to the participants. This material is suggested to be used and discussed with the instructor. At this time, you may want to review your policies and procedures regarding the treatment of hypoglycemic reactions.

Audio Visual Materials

The following film strip and audio tape are available on loan from Vocational Education Services, Indiana University:

Information on Diabetes (AV070046)

These include two programs on diabetes—what diabetes is and how to prevent the problem of non-insulin dependent diabetes. The material explains the causes and controls of the disease and identifies oral agents used to control non-insulin dependent diabetes.

Antidiabetic Agents

Goal

It is sometimes necessary to administer antidiabetic drugs to the patient who is unable to utilize the body's sugar (glucose) as fuel to produce energy. The goal of this module is to increase the awareness and understanding of the health care worker who is administering these medications to diabetic patients. By increasing the knowledge of the disease process of diabetics and presenting the actions, side effects and interactions of antidiabetic agents, the person administering these drugs will provide the patient with some means of controlling the disease and appreciating the factors involved in the maintenance of that control.

Objectives

After completing this module, the participant will:

- Describe how antidiabetic drugs act on the body.
- Describe the source and function of "natural" insulin.
- Name the symptoms of Diabetes Mellitis.
- Name 3 injectable drugs and 3 oral hypoglycemic agents, their side effects and interactions with other drugs.
- Differentiate the symptoms of Hypoglycemia and Hyperglycemia.
- Complete the worksheet with the instructor.

General Discussion

More than 4 million persons in the United States have diabetes. Once the disease is diagnosed, lifelong therapy is required. Poorly controlled diabetes contributes to the incidence of circulatory disease, renal disease and other complications. However, complications may occur even in well-controlled diabetes.

Diabetes is controlled by insulin therapy, hypoglycemic drugs, and a prescribed diet. Insulin is an injectable hormone. Oral hypoglycemic agents are used in mild forms of diabetes.

Diabetes Mellitis

Normal, healthy people have a certain amount of *glucose* (sugar) in the blood. Glucose is the fuel which the body uses to produce energy. We obtain glucose in the foods we eat.

The amount of glucose in the blood is regulated by a hormone from the *pancreas*, a gland located in the back of the abdominal cavity. This hormone is called *insulin*. Insulin is poured directly into the bloodstream from small cells in the pancreas called the *Islets of Langerhans*. The function of insulin is to lower the concentration of sugar in the blood by changing sugar (glucose) to glycogen. Glycogen is a fuel the body can use for energy.

Diabetes Mellitis is a condition in which the pancreas is unable to secrete enough of the hormone insulin. When this happens, several things occur in the body:

- Excess sugar collects in the blood (*hyperglycemia*)
- Some sugar is excreted with the urine (*glycosuria*)
- Large amounts of urine are produced in body's attempt to remove excess sugar (*polyuria*)
- Patient urinates frequently in large amounts (*polyuria*)
- Patient is constantly thirsty, trying to replace water (*polydipsia*)

Sugar (glucose) is not being used as fuel for the body's energy needs. To compensate for the sugar, the body begins to burn protein and fat. Classic symptoms of diabetes develop.

- Extreme hunger and thirst
- Production of excess urine
- Itching in genital region
- Weight loss
- Weakness
- Urine tests show large quantities of sugar in urine

Complications of Diabetes Mellitis

Over a period of time, diabetes causes damage to tissues and organs. Some complications of Diabetes Mellitis are: disorders of the Vascular System (arteries and veins). Thickening in the walls of capillaries, arteries and veins causes:

- Visual problems—impaired vision—blindness
- Leg cramps, ulcer formation, and gangrene
- Nerve damage as exhibited by
  - facial paralysis
  - diarrhea
  - constipation
  - inability to empty urinary bladder (atony)
  - itching, numbness, tingling of legs
  - loss of sensation to heat or cold
- Kidney damage may lead to renal failure
- Infection—heals slowly
- Arteriosclerosis—incidence higher in diabetics
- Urinary and vaginal infections

Antidiabetic Agents

Antidiabetic drugs are used in the management of diabetes mellitis:
Insulin—A hormone obtained from the pancreas of animals, insulin is inactivated by the gastric juices, so it must be injected and cannot be taken orally. The drug is given when diabetes is severe, or if the patient has acute complications such as a severe illness or infection. It is sometimes given in addition to other oral hypoglycemic agents. Insulin requirements have a narrow margin between a therapeutic and toxic dose; these requirements are individualized for each patient. The dose must be given at the same time of day to insure correct response. Too little insulin causes hyperglycemia (see drug chart for symptoms of hyperglycemia); too much insulin may cause hypoglycemia (see drug chart for symptoms). Insulin may have short acting, intermediate acting or long acting effects.

Hypoglycemic Drugs—are derivatives of the "sulfa" drugs, which are used in mild forms of diabetes. They can be given orally in addition to insulin. These drugs stimulate the Islets of Langerhans to increase natural insulin secretion. Hypoglycemic drugs can only be given to patients who have some functioning cells left in the pancreas. They may have a toxic effect (hypoglycemic reaction) anytime from 30-60 minutes to many hours later (see drug chart for symptoms). Such drugs must be given at the same time of day to insure correct response.

Management of Diabetes

The person with diabetes has a chronic, complex disease. The test for diabetes is a relatively simple procedure. Because glucose is excreted in the urine and spills over into the bloodstream in abnormally large amounts, the urine and blood can be examined for the presence of sugar.

These examinations, or tests, are also performed routinely on the diabetic patient *to monitor the amount of sugar in the blood and urine*. The tests tell us how well the sugar is being controlled, if toxic or side effects are developing, and whether or not the dosage of the antidiabetic drugs needs to be increased or decreased.

Urine tests to detect glucose (sugar)

Tes-tape—strip of tape dipped into urine—if glucose is present, the tape will turn green or blue.

Clinitest—10 gtts of water placed in test tube with 2-5 gtts of urine; clinitest tablet is added; reaction occurs; color of solution is compared to color chart to detect sugar in urine.

Clinistix—strips of coated plastic that are dipped in urine and color reaction is compared to a chart to determine amount of sugar in urine.

Diastix—similar to Clinistix, a plastic strip is dipped in urine and compared to color chart.

Ketones

If the body does not produce enough insulin to convert sugar to energy, the body begins to burn fat. Ketones are the result of fat being used for energy rather than sugar. Ketones can accumulate in the body and become toxic. Ketones contain another element called acetone. When a diabetic patient develops an infection, has nausea or vomiting or increases the need for the conversion of sugar to energy that the usual medication does not supply, then the patient can develop a *diabetic coma* or *diabetic ketoacidosis (DKA)* (see drug chart for symptoms of diabetic coma). Testing for ketones becomes especially important when the patient is ill or has a high concentration of glucose in his urine.

Ketostix—test the urine for ketones
Dia-stix—test the urine for glucose and ketones

Blood tests

Blood tests to detect the presence of glucose are ordered by the physician and performed by the laboratory. However, some facilities and patients may perform their own tests by using

- Fasting blood sugar—single specimen of blood taken in the morning following 8 hours of fasting
- Postprandial glucose—single sample of blood tested 2 hours after patient has eaten
- Glucose tolerance test—the *normal amounts* of sugar in the blood is *80 mg to 120 mg per 100 ml. of venous blood.* In the diabetic, sugar in the form of glucose is given to the patient to drink. After the blood is tested hourly, the blood sugar level remains higher than in persons without diabetes.

Hypoglycemia

Insulin Shock
Hyperinsulinsm

Early Symptoms:
- behavior changes (moody, irritable, giddy)
- tachycardia
- diaphoresis
- blurred vision
- headache
- hunger
- fatigue, tremors
- paleness
- numbness of extremities
- yawning, incoordination

Late Symptoms:
- loss of consciousness
- coma
- convulsions

Hyperglycemia

Diabetic Coma
DKA

Early Symptoms:
- slow onset
- flushed, hot, dry skin
- drowsiness
- breath smells fruity (acetone)
- low B/P
- vomiting
- thirst
- large amt.—sugar in urine
- Kussmaul breathing (fast, deep)

Late Symptoms:
- unconsciousness
- coma
- death

Role of the Health Care Worker

Administers oral hypoglycemic agents in the care of the diabetic resident.

The health care worker must be able to recognize symptoms of both hypo- and hyperglycemia.

Causes of low blood sugar (hypoglycemia)—the resident may experience a drop in blood sugar due to:

- Increased physical exertion
- Gastrointestinal upsets—anorexia, nausea/vomiting
- Accumulation of oral hypoglycemic drugs
- Hyper secretion of insulin by the pancreas
- Interaction with other drugs

Causes of high blood sugar (hyperglycemia)

- Poor adherence to diet
- Inadequate regulation of hypoglycemic agents
- Interaction with other drugs

Other considerations

- Observe for gastrointestinal bleeding
- Check resident for skin rash, bruising, jaundice
- Medication may be given after meals to prevent nausea or vomiting
- Chart and record resident's dietary intake from observations
- Elderly residents may be highly responsive to oral hypoglycemic agents
- Residents who have renal or liver impairment or who suffer from malnutrition must be observed closely for severe hypoglycemic reactions

Drug Interactions

Sulfonylureas (acetohexamide, chlorpropamide, tolazimide, tolbutamide) may interact with:

- Insulin, sulfonamides, oxyphenbutazone, phenylbutazone, salicylates, probenacid, MAO inhibitors, dicumarol and bishydroxycoumarin to prolong or enhance the action of sulfonylureas which will increase the risk of hypoglycemia
- Thiazide diuretics causing an aggravated diabetic state and increased sulfonylurea requirements
- Alcohol to produce a "disulfiram reaction," throbbing in head and neck, respiratory difficulty, nausea, vomiting, sweating, thirst, chest pain, palpitation, confusion

Insulins may react with:

- Metroprolol and propanolol to produce hyper or hypoglycemia
- Acetazolamide, adrenergic agents, corticosteroids, glucagon, and rifampin to produce a decreased insulin response
- Thiazide diuretics, thyroxin, and alcohol to produce a decreased insulin response
- Allopurinol, anabolic steroids, and colfibrate, quanethadine, halofenate, MAO inhibitors, phenylbutazone, salicylates, sulfonamides, oral anticoagulants to produce an increased insulin response

Worksheet

1. Describe how hypoglycemic drugs affect the body
   1. 2.

2. Describe the source and function of natural insulin

3. Name the symptoms of Diabetes Mellitis

4. Name 3 injectable drugs and 3 oral hypoglycemic agents, their side effects and interactions with other drugs

5. Differentiate the symptoms of hypoglycemia and hyperglycemia

6. Discuss the situation with your instructor. Be prepared to explain your answer(s).

Situation for class discussion. Discuss this situation with your instructor. Be prepared to explain your answer(s).

Mrs. Sever developed Diabetes Mellitis 3 years ago. She has been a patient at the facility for the last 6 weeks as a result of a severe infection on her leg. She is mentally alert and was quite active before her hospitalization. She is receiving 30 units of regular insulin and an oral hypoglycemic drug, Diabenese, daily.

The following questions pertain to this situation. Choose the best answer(s).

1. Mrs. Sever's diabetes is caused by:
   a. a lack of glucose in the blood
   b. an increase of the hormone, insulin
   c. a decrease of insulin in the blood
   d. an abundance of glucose in the blood

2. If Mrs. Sever should experience hypoglycemia, early signs might be
   a. behavior changes, perspiring, hunger
   b. dry hot skin, drowsiness
   c. vomiting, thirst
   d. unconsciousness, coma, death

3. Mrs. Sever's *insulin* is given by which route?
   a. oral
   b. sublingual
   c. injected
   d. intravenous

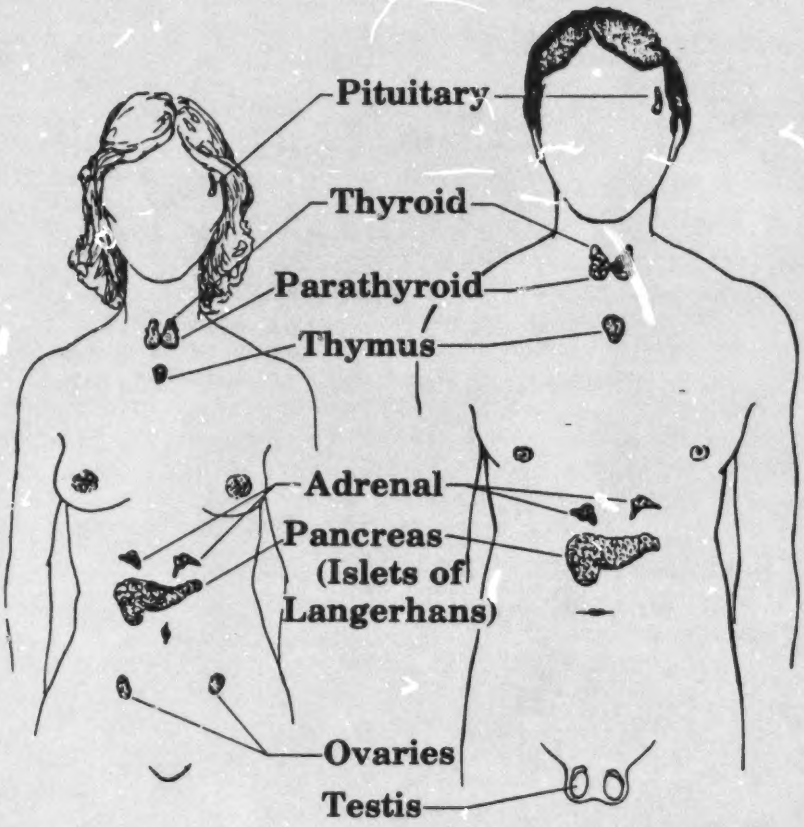
4. Mrs. Sever receives daily injections of insulin and oral hypoglycemic drugs. It is extremely important to insure the patient's correct response to the drug by
   a. performing a Clinitest on her urine
   b. performing an Acetest on her urine
   c. administering the medication at the same time
   d. administering the medication after meals

5. The degree of diabetic control through the administration of antidiabetic drugs can best be monitored by
   a. regulation of dietary intake
   b. maintenance dosages of antidiabetic agents
   c. Clinitest and Acetest examinations at specified intervals
   d. the frequency of hypoglycemic reactions

6. Mrs. Sever has been on antidiabetic drugs for at least 6 months. It is highly probable that she will
   a. recover from her disease soon
   b. need adjustments in her dosage periodically
   c. discontinue periodic examinations of her urine
   d. be able to eat whatever she wants

7. If Mrs. Sever should produce signs of diabetic coma, you would expect the following symptoms
   a. sweating, tachycardia
   b. tingling or numbness
   c. nervousness, tremors
   d. hot, dry, skin, sweetish odor on breath

ENDOCRINE SYSTEM



FUNCTION:
SECRETES HORMONES TO REGULATE BODY PROCESSES OF GROWTH AND DEVELOPMENT; REGULATES BODY FUNCTIONS, METABOLISM AND REPRODUCTION

Considerations for Care

Considerations	Suggested Activities
Enable patient to maintain best control of diabetes.	Encourage patient to take medication regularly and to follow prescribed diet.
Be aware of degree of diabetic control.	Test urine for both acetone and sugar at specified intervals and when symptoms of hypoglycemia or hyperglycemia develop.
Prevent complications to feet.	Feet should be inspected routinely; bathe in warm (never hot) water; nails, corns, callouses should be seen by a podiatrist.
Prevent hypoglycemic reactions (most common complication in patients receiving antidiabetic medication).	Recognize early symptoms and follow facility policy or physician's order regarding administering orange juice, candy, ginger ale, etc.
Insure patient's correct response to medication.	Administer medication at same time every day.

Vocabulary

These words were included in your lecture—match the correct definition by placing the correct number from column B into correct response in column A.

A	B
_____ glycosuria	1. low blood sugar
_____ polydipsia	2. diabetic ketoacidosis
_____ hyperglycemia	3. hypoglycemic drugs
_____ atony	4. hormone in pancreas
_____ hypoglycemia	5. sugar in urine
_____ DKA	6. fat being used for energy
_____ antidiabetic agents	7. monitors amount of sugar in blood
_____ insulin	8. increased thirst
_____ ketones	9. weakness, inability to function properly
_____ Clinitest	10. high blood sugar
	11. monitors amount of sugar in urine

Oral Hypoglycemic Agents

Drug	Side Effects	Interacts With	To Produce	Remember
Acetohexamide Dimelor Dymelor **Chlorpropamide** Chloronase Diabenese Novopropamide Stabinol **Tolazimide** Tolinase **Tolbutamide** Mellatol Mobenol Neo-Dibetic Novobutamide Orimide Orinase Tolbutone	Irritability Headache Inability to concentrate Fatigue Dizziness Coma Increased heart rate Loss of appetite Nausea/vomiting Diarrhea Hunger Low blood sugar Rash S.O.B.	**Allopurinol** Zyloprim **Anabolic steroids** Deca-Durabolin Dianabol Durabolin Winstrol **Clofibrate** Atromide-S **Quanethadine** Ismelin **Halofenate** **MAO Inhibitors** Eutonyl Marplan Nardil Parnate **Phenylbutazone** Butagesic Butazolidine Anervil	Increased hypoglycemic response	**Increased Hypoglycemic Response** (Hypoglycemia) (Insulin shock) **Symptoms** Early—behavior changes (moody, giddy, belligerent) Tachycardia Diaphoresis Blurred vision Headache Hunger Fatigue Tremors Paleness Numbness of extremities Yawning Incordination Late—loss of consciousness Coma Convulsions Treatment—check policy—If conscious, may give fruit juice or ginger ale.

continued below

Drug Worksheet #1

Oral Hypoglycemic Agents

Drug	Side Effects	Interacts With	To Produce	Remember
		Salicylates Aspirin Bufferin **Sulfonamides** Gantrisin Septra Thiosufil Gantonol **Oral anticongulants** Coumadin Panwarain Athrombin K		**Cause** • patient receives too much injected insulin • blood sugar uncontrollable • too little food eaten after receiving medicine • vomiting soon after a meal • too much exercise *Hypoglycemia may occur with use of sulfonylureas. It may occur anytime from 30-60 min. to many hours later.

Drug Worksheet #1

Oral Hypoglycemic Agents

Oral hypoglycemic agents stimulate specialized cells in the pancreas to produce insulin which is required for the metabolism of sugar.

Drug	Onset	Peak	Duration	Interacts With	To Produce	Remember
Intermediate-Acting **Acetohexamide** Dimelor Dymelor	1½ hr	3 hr	12-14 hr	**Acetazolamide** Diamox Hydrazol Acetozolom	Decreased hypoglycemic response	**Decreased Hypoglycemic Response** (Hyperglycemia) (Diabetic Coma) (DKA)
Long Acting **Chlorpropamide** Chloronase Diabenese Novopropamide Stabinol	1 hr	3-6hr	72 hr	**Adrenergic agents** (sympathomimetics) Intropin Wyamine Aramine Neo-Synephrine (nasal spray)		**Symptoms** Early-slow onset Flushed, dry hot skin Drowsy i,beath smells fruitty (acetone) B/P low Vomiting Thirst Large amount sugar in urine Kussmaul breathing (fast deep) Unconsciousness Coma death
Intermediate-Acting **Tolazamide** Tolinase	4-6 hr	4-8 hr	10 hr	**Corticosteroids** Aristocort Decadron Hydrocortisone Prednisone Cortisone Deltasone Medrol		

continued below

Drug Worksheet #2

Oral Hypoglycemic Agents

Oral hypoglycemic agents stimulate specialized cells in the pancreas to produce insulin which is required for the metabolism of sugar.

Drug	Onset Peak Duration	Interacts With	To Produce	Remember
Short Acting **Tolbutamide** Mellatol Mobenol Neo-Didetic Orimide Orinase Tolbutone	½ hr 3-5 hr 6-12 hr Irritability Headache Inability to concentrate Fatigue Dizziness Coma Increased heart rate Loss of appetite Nausea/vomiting Diarrhea Hunger Low blood sugar Rash S.O.B.	**Glucagon** **Rifampin** Rifadin **Thiazide diuretics** Diuril Hydro-Diuril Enduron Aldactazide Dyazide **Thyroxine** **Alcohol**		**Cause** • Acute insulin deficiency • Inadequate medical care • Infection • Blood sugar uncontrollable

Insulins

An injectable hormone which replaces the natural supply of insulin when the pancreatic cells fail to produce it.

Drug	Onset Peak Duration	Interacts With	To Produce	Remember
Rapid-Acting (regular insulin, regular iletin) (semilente iletin, semilente insulin)	½-1 hr 2-3 hr -7hr ½-1 hr 4-7 hr 12-16 hr	**Metroprolol** Betaloc Lopressor **Propanolol HCL** Inderal	Hyperglycemia Hypoglycemia	See drug worksheet #1 and #2.
Intermediate-Acting **Globin zinc insulin**	2 hr 8-16 hr 18-24 hr	**Acetazolamide** Diamox Hydraol Acetozolom	Decreased insulin response	See drug worksheet #2 (Hyperglycemia)
Insulin zinc suspension (Lente Insulin, Lente Iletin)	1-2 hr 8-12 hr 18-24 hr	**Adrenergic agents** (sympathomimetics) Intropin Wyamine Aramine Neo-Synephrine (nosal spray)		
Isophane insulin suspension (NPH insulin NPH iletin)	1-2 hr 8-12 hr 18-24 hr			

continued below

Drug Worksheet #3

Insulins

An injectable hormone which replaces the natural supply of insulin when the pancreatic cell fail to produce it

Drug	Onset Peak Duration	Interacts With	To Produce	Remember
Long-Acting **Extended insulin zinc suspension** Ultralente Iletin Ultralente Insulin) **Protamine zinc insulin suspension** Protamine Zinc Insulin	4-8 hr 16-18 hr 36 hr 4-8 hr 14-20 hr 36 hr	**Corticosteroids** Aristocort Decadron Hydrocortisone Prednisone Cortisone Deltasone Medrol **Glucagon** **Rifampin** Rifadin		

Insulins

Drug	Side Effects	Interacts With	To Produce	Remember
Rapid-Acting (regular insulin, regular iletin) (semilente iletin, semilente insulin) *Intermediate-Acting* (Globin zinc insulin **Insulin zinc suspension** (Lente Insulin, Lente Iletin) **Isophane insulin suspension** (NPH insulin, NPH iletin) *Long-Acting* **Extended insulin zinc suspension** (Ultralente Iletin Ultralente Insulin) **Protamine zinc Insulin suspension** Protamin Zinc Insulin	Uncontrolled yawning Tingling in fingers Confusion Agitation Lethargy Fatigue Tremor Headache Nightmares Irritability Tachycardia Blurred vision Itching, Swelling Stinging at the site of injection Increased appetite Nausea-vomiting Hypoglycemia	**Thiazide diuretics** Diuril Hydro-Diruil Enduron Aldactazide Dyazide **Thyroxin** **Alcohol**	Decreased insulin response	See drug worksheet #1.
		Allopurinol Zyloprim **Anabolic steroids** Deca-Durabolin Dianabol Durabolin Winstrol **Colfibrate** Atromide-S **Quanethadine** Ismelin **Halofenate** **MAO Inhibitors** Eutonyl Marplan Nardil Parnate	Increased insulin response	See drug worksheet #2.

continued below

Drug Worksheet #4

Insulins

Drug	Side Effects	Interacts With	To Produce	Remember
		Phenylbutazone Butagesic Butazolidine Anervil **Salicylates** Aspirin Bufferin **Sulfonamides** Gantrisin Spetra Thiosufil Gantanol **Oral Anticongulants** Coumadin Panwardin Athrombin K		